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Distribution Automation: The Next Big Push?

Evaluating the Business Case for Distribution Automation at Electric Cooperatives

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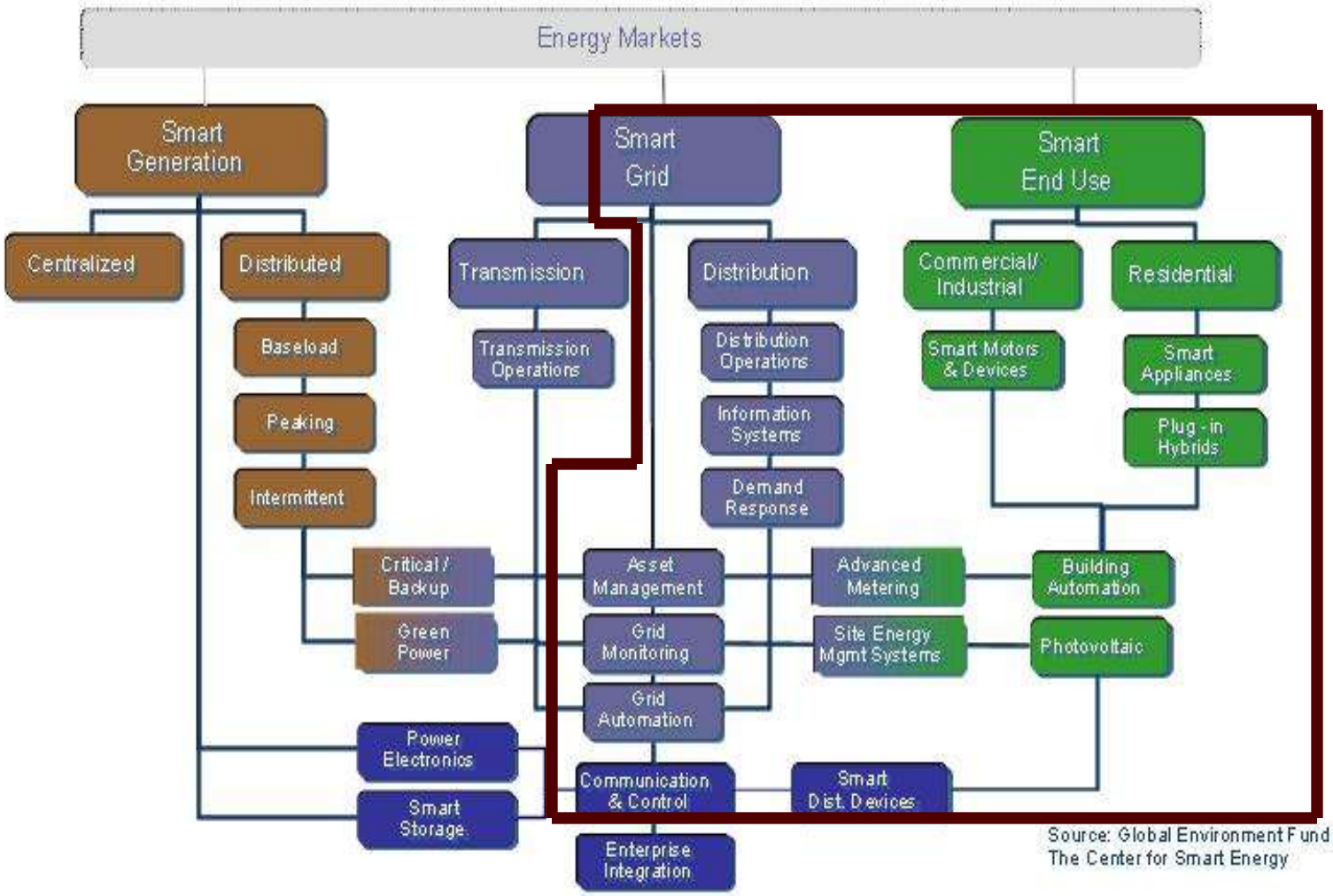
Smart Grid Leading Edge

- **Smart Grid 1.0: → 2010**
  - AMI/smart meters
  - Customer pricing/engagement focus
- **Smart Grid 2.0: 2011 →**
  - Distributed communication,intelligence and control throughout the distribution system
    - Substation, feeders
    - Equipment in businesses and homes
  - Integration of distributed resources

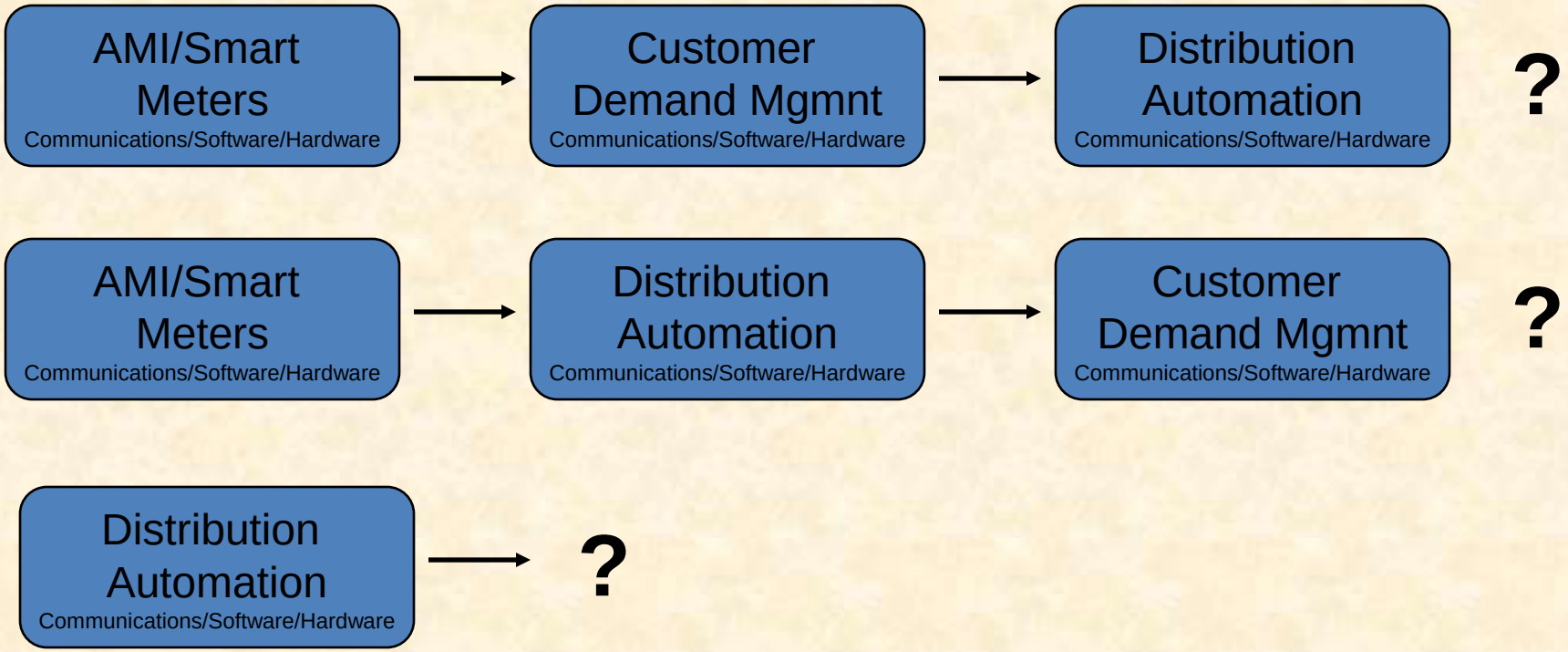
What Does This Mean for Coops?

- AMI/smart meter applications being viewed as more “mainstream”
- Growing number of DA “use cases”
- More information for utility decision-makers to consider SG options throughout the distribution system
- Satisfies a “not the first but not the last” criterion for substation to customer investments

Expanding the Scope of SG Options Complicates Investment Decisions



What Role Should DA Play in Coop Smart Grid Strategies?



Quantitative Financial Investment Analysis Can Provide Insights on Appropriate DA Role

- Consider
  - Costs and benefits of important technologies/applications
  - Unique utility/utility customer characteristics
  - Utility monthly hourly loads and SG load impacts
    - Avoided power purchase costs
- Conduct “what-if” scenario analysis
  - Quantitative model framework

Example Coop Analysis Illustrates Consideration of DA Role

- **Smart Grid Investment Model**
  - Developed in 2010 Smart Grid Research Consortium
    - 8 coops, 3 municipal, 1 PPD, 1 generation utility
  - Excel platform with "callable" monthly hourly load forecasting model

Table 1. Smart Grid Research Consortium Member Utilities
1. Bandera Electric Cooperative
2. Bastrop Power and Light
3. Bluebonnet Electric Cooperative
4. CPS Energy
5. Gainesville Regional Utilities
6. Houston Country Electric Cooperative
7. Independence Power & Light
8. Lawrenceburg Utility Systems
9. Lower Colorado River Authority
10. Midwest Energy Cooperative
11. Nebraska Public Power District
12. Pedernales Electric Cooperative
13. Southwest Louisiana Electric Membership Corporation

- **"Representative Coop"**
  - ~100,000 customers, 0.65 system load factor; $0.05/kWh, $12/kW summer; $0.02-0.03/kWh, $6-8/kW spring/fall/winter
  - Residential: 70% customers, 60% kWh coincident peak kW

Cost/Benefits Summary

Smart Grid Benefit Cost Summary

	Application Area		
	AMI/Smart Meters	**Distribution Automation**	**Customer Programs**
Benefits	Meter reading Field services Outage restoration Billing services Theft/tampering Meter accuracy Uncollectables Improved cash flow Resource planing Improved transformer load management	Reliability Improved power quality Field services Outage restoration Environmental Reduced capital costs Reduced O&M costs Reduced power costs Distributed energy resources Improved equipment management/planning	Customer participation Customer satisfaction Reduced power costs Environmental Distributed energy resources Other/new services
Costs	Communications Software Hardware Management/Operational	Communications Software Hardware Management/Operational	Communications Software Hardware Management/Operational

Replacing EM Meters With AMI Typically Provides Attractive Returns

- No Customer Programs

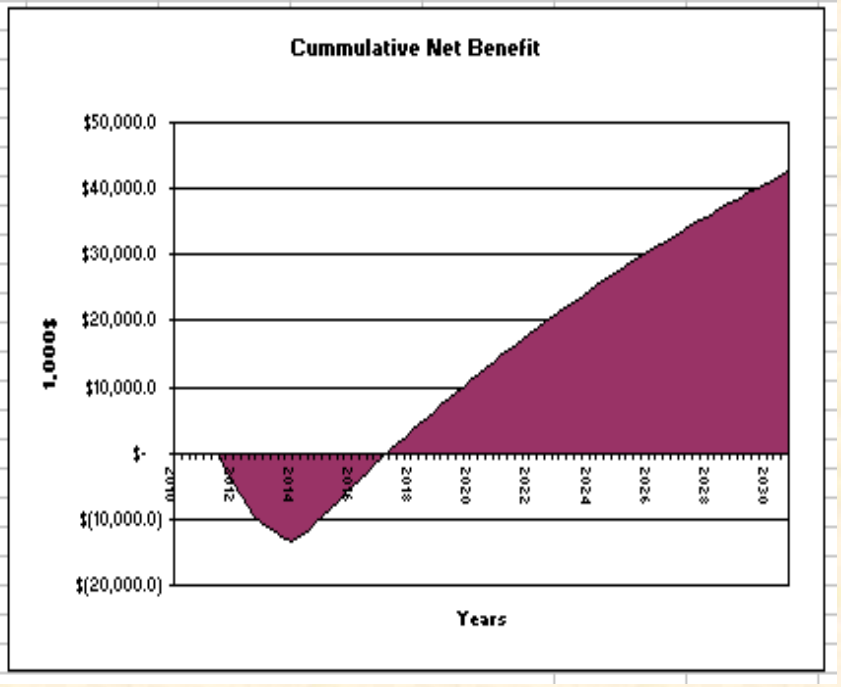
SUMMARY RESULTS

Analysis Title:	Smart Grid Investment Model Baseline Forecast		
	Annual	Quarterly	
Discount Rate	5.00%	1.23%	
Project Financial Indicators			
Net Present Value (NPV, $1,000)	$ 42,472		
Internal Rate of Return (%)	28.0%		
	Year	**Quarter**	**Payback (years)**
Smart Grid Initiation	2011	4	
Undiscounted Breakeven Period	2017	1	**5.25**
Discounted Breakeven Period	2017	2	**5.50**
Expenditures and Benefits to 2030 ($1,000)			
	Nominal	**Discounted**	
Total Capital Expenditures	$ 24,833	$ 21,158	
Total O&M Expenditures	$ 729	$ 444	
Total Benefits	$ 112,545	$ 64,073	

Update Results

Green-filled cells designate user input areas.

2010$ for end-of-year and end-of-quarter in Thousand Dollars unless otherwise shown



However, Coops With AMR Systems May Have Difficulty Justifying AMI

- PLC with remote connect/disconnect

SUMMARY RESULTS

Analysis Title:	Smart Grid Investment Model Baseline Forecast		
	Annual	Quarterly	
Discount Rate	5.00%	1.23%	
Project Financial Indicators			
Net Present Value (NPV, $1,000)	$ 1,526		
Internal Rate of Return (%)	5.9%		
	Year	**Quarter**	**Payback (years)**
Smart Grid Initiation	2011	4	
Undiscounted Breakeven Period	2024	1	**12.25**
Discounted Breakeven Period	2029	1	**17.25**
Expenditures and Benefits Over 20 Years ($1,000)			
	Nominal	**Discounted**	
Total Capital Expenditures	$ 24,838	$ 21,340	
Total O&M Expenditures	$ 729	$ 444	
Total Benefits	$ 40,893	$ 23,310	

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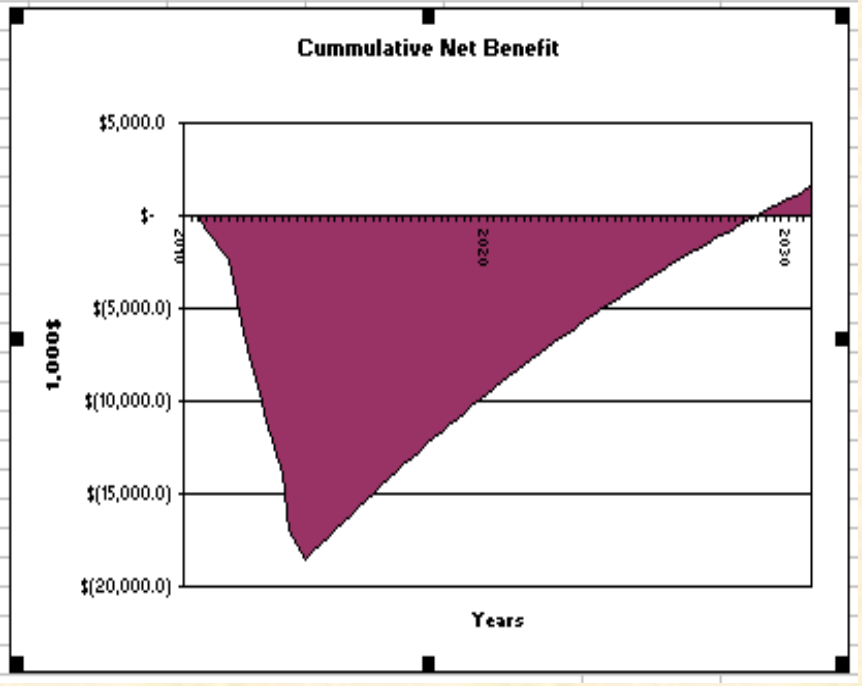

Customer Programs Can Improve AMR→AMI Returns

- 20 % PCT/pricing + 30% cust engagement (5% AC/SH savings)

SUMMARY RESULTS

Analysis Title:	Smart Grid Investment Model Baseline Forecast		
	Annual	Quarterly	
Discount Rate	5.00%	1.23%	
Project Financial Indicators			
Net Present Value (NPV, $1,000)	$ 24,184		
Internal Rate of Return (%)	17.6%		
	Year	**Quarter**	**Payback (years)**
Smart Grid Initiation	2011	4	
Undiscounted Breakeven Period	2018	2	**6.50**
Discounted Breakeven Period	2019	2	**7.50**
Expenditures and Benefits to 2030 ($1,000)			
	Nominal	**Discounted**	
Total Capital Expenditures	$ 27,126	$ 23,370	
Total O&M Expenditures	$ 19,873	$ 10,914	
Total Benefits	$ 101,824	$ 58,468	

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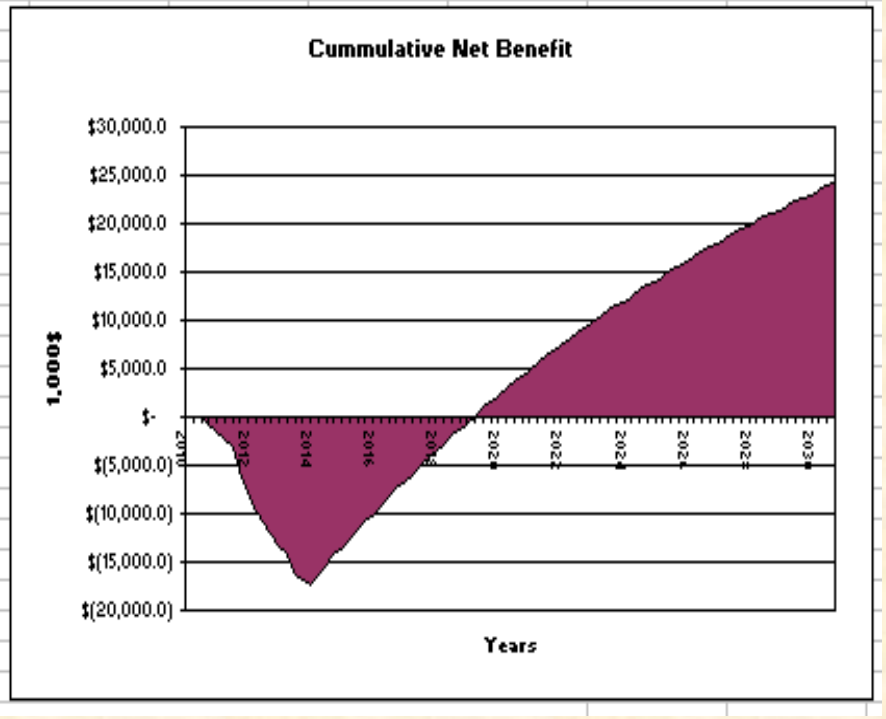


Consider DA Impact of Conservation Voltage Regulation (Reduction), CVR

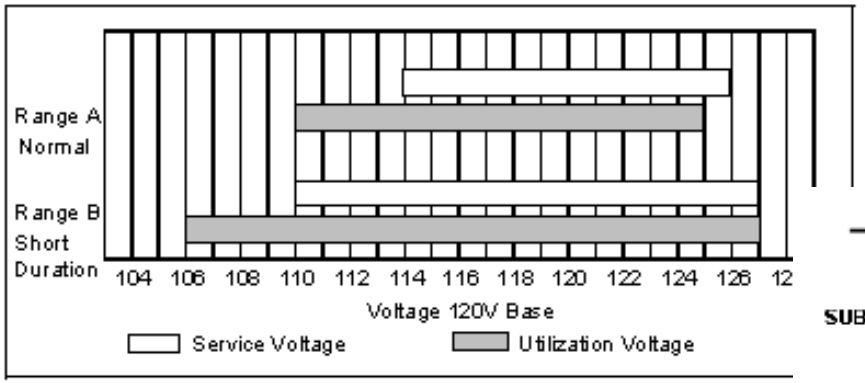
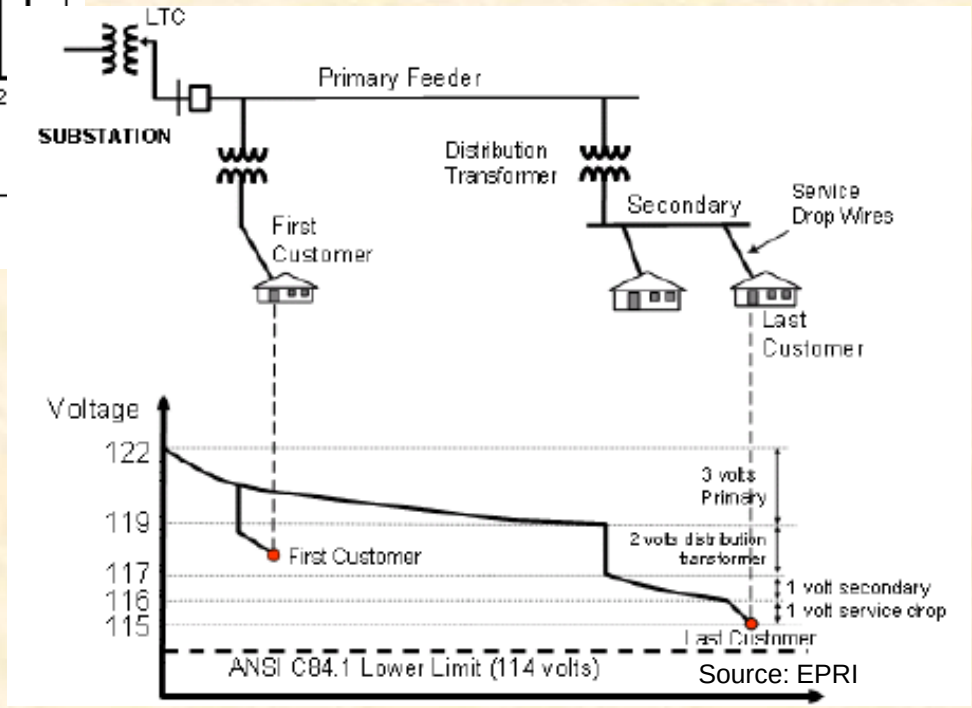


Figure 1-1
ANSI C84.1 Voltage Ranges

Source: RWBeck

VVC Objective: Maintain acceptable voltage under all loading conditions



Conservation Voltage Regulation factor (% change in kWh/kW from 1% change in Voltage)

	kW	kWh
Elec, No AC	0.40	0.25
Elec, AC	0.35	0.40
Non, AC	0.74	0.60
Non, No AC	0.81	0.40

Source: Distribution Efficiency Initiative Study

- CVR Advantages
  - No customer participation required
  - Options: manual adjustments → full automation
  - Utility & customer savings

How Does CVR Stack Up as a 1st Step ?

- $50k/substation; 1% voltage reduction

SUMMARY RESULTS

Analysis Title:	Smart Grid Investment Model Baseline Forecast	
	Annual	Quarterly
Discount Rate	5.00%	1.23%
Project Financial Indicators		
Net Present Value (NPV, $1,000)	$ 3,162	
Internal Rate of Return (%)	36.4%	

	Year	Quarter	Payback (years)
Smart Grid Initiation	2011	4	
Undiscounted Breakeven Period	2015	2	**3.50**
Discounted Breakeven Period	2015	4	**4.00**

Expenditures and Benefits to 2030 ($1,000)	Nominal	Discounted
Total Capital Expenditures	$ 1,272	$ 1,119
Total O&M Expenditures	$ 313	$ 182
Total Benefits	$ 7,742	$ 4,464

Update Results

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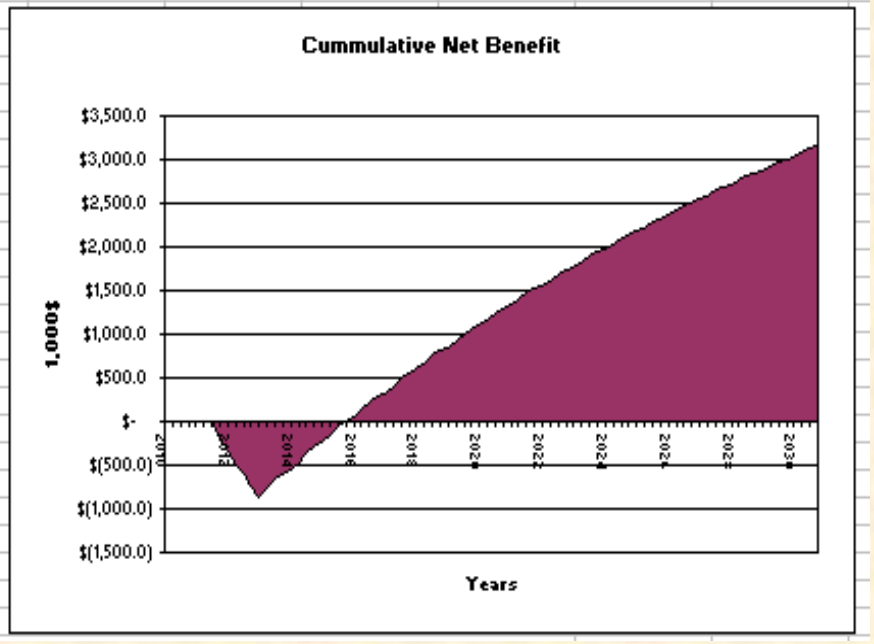

More Extensive Conservation Voltage Regulation Saves Even More

- $250k/substation; 4% voltage reduction

SUMMARY RESULTS

Analysis Title:	Smart Grid Investment Model Baseline Forecast		
	Annual	Quarterly	
Discount Rate	5.00%	1.23%	
Project Financial Indicators			
Net Present Value (NPV, $1,000)	$ 10,908		
Internal Rate of Return (%)	26.4%		
	Year	**Quarter**	**Payback (years)**
Smart Grid Initiation	2011	4	
Undiscounted Breakeven Period	2016	2	**4.50**
Discounted Breakeven Period	2017	1	**5.25**
Expenditures and Benefits to 2030 ($1,000)			
	Nominal	**Discounted**	
Total Capital Expenditures	$ 6,480	$ 5,702	
Total O&M Expenditures	$ 313	$ 182	
Total Benefits	$ 29,124	$ 16,793	

Update Results

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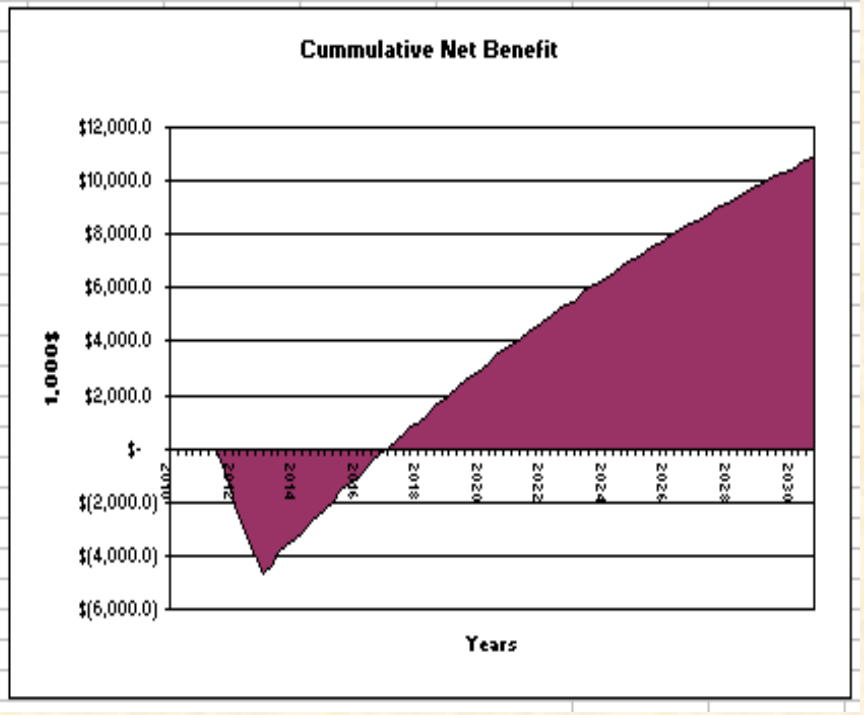

CVR Savings Can Justify a DA/AMI Initiative at the AMR Utility Even W/O Cust Programs

- Additional 1% voltage reduction using meters for EOL voltage
- Without customer programs in this scenario

SUMMARY RESULTS

Analysis Title:	Smart Grid Investment Model Baseline Forecast		
	Annual	Quarterly	
Discount Rate	5.00%	1.23%	
Project Financial Indicators			
Net Present Value (NPV, $1,000)	$ 25,588		
Internal Rate of Return (%)	16.5%		
	Year	**Quarter**	**Payback (years)**
Smart Grid Initiation	2011	4	
Undiscounted Breakeven Period	2018	4	**7.00**
Discounted Breakeven Period	2020	1	**8.25**
Expenditures and Benefits to 2030 ($1,000)			
	Nominal	**Discounted**	
Total Capital Expenditures	$ 30,358	$ 26,197	
Total O&M Expenditures	$ 1,042	$ 626	
Total Benefits	$ 91,491	$ 52,411	

Update Results

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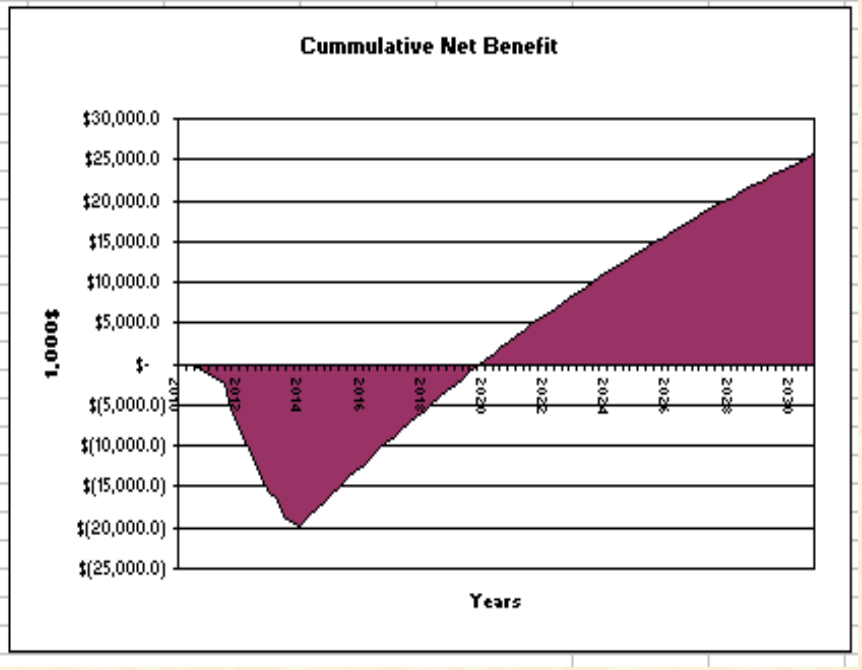

DA, The Next Big Push?

- Generally: Yes
  - CVR is likely to provide the best "primary" SG financial returns for many electric cooperatives utilities who already have AMR systems
    - Other DA activities improve reliability, outage management/recovery, dist field services/maintenance, etc.
  - DA investments may outperform AMI/smart meter investments even when replacing EM meters
- However …
  - Individual utility characteristics vary so AMI and Cust Programs can reflect better returns than DA, and
  - DA, AMI/smart meters and customer program options should be evaluated singly and in combination to develop utility-specific least-cost, maximum-benefit SG strategies

2011 Smart Grid Research Consortium

- Activities
  - SG Investment Model implemented for member utilities
  - Model extensions
  - Workshop/Conference: 10/20-21, Orlando
- Membership is still open
  - $15,000 membership fee

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